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A review of Technology Education in Ireland; a changing technological environment promoting design activity

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Abstract In Ireland, Technology Education's structure and organisation across the levels of education is not delivered or governed in a coherent manner. Technology Education in primary level education, for students between 5 and 12 years of age, does not explicitly exist as a separate subject. In primary level education, Social, Environmental and Scientific Education (Science), encourages a child to examine and appreciate how technology and science impacts on their lives and the environment. It supports children developing design and make skills, and to apply scientific ideas to everyday situations and practical problems (DES in Primary school curriculum, science. Social, environmental and scientific education curriculum, 1999). In addition, various initiatives such as the Junior Lego League, supported by the Galway Education Centre, facilitate various perspectives of Technology Education. In second level education, which this paper primarily focuses on, Technology Education exists as a suite of eight subjects, for students of 12–18 years of age. In third level education students can choose from a wide range of bachelor degree programmes in science, technology, engineering or maths. The degree programmes available at third level also include programmes in initial teacher education (ITE). These programmes in initial teacher education are offered by two institutions, and graduate second level teachers to service the second level system. Technology Education in second level education was first introduced to Ireland in 1885. Since this introduction, revisions and changes have occurred, in both the Irish economy and syllabi. In 2006, Technology Education syllabi were revised to include more design activity at senior cycle. These changes reflect the forward thinking of policy makers in reflection of the progression from the industrial era to the information era to the conceptual era. The scope of second level Technology Education in an Irish context is still perceived by many as vocational, though progressive reformations are advancing towards a design-driven framework, grounded in a strong craft practice. This

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changing technological environment has resulted in the promotion of design activity in second level Technology Education in Ireland. This paper reviews the establishment of design education in Technology Education in the Irish second level education context, where an epistemological shift towards design activity has occurred.

Keywords Technology Education · Second level education · Design activity · Technological environment

Introduction

This paper explores second level Technology Education in Ireland, with a focus on exploring and explaining the changing emphasis and inclusion of design. Technology Education in Ireland has a strong ethos and value system, which has stemmed from a strong vocational practice. The initial entry of Technology Education to the Irish education system occurred in 1885. In 2006, a review of Technology Education at second level education commenced, with four proposals of change. The objective of the revisions was to give students a balanced education, developing knowledge, understanding and skills through creative design activity for a technological world. Evidence that two proposals of the reformation are successfully progressing is evidenced by the State Examination Commission, Chief Examiners Reports, which are discussed in a later section. However, economic factors limited the progression of second level Technology Education reformation in recent years. This has resulted in curriculum changes in practice dominated by assessment rather than curriculum drive. As a result the pedagogical approaches and strategies for creative design activity are evident in the context of product (output) rather than process (means).

Akin to this, design as an academic subject, in third level institutions, is a relatively new 'academic profession' (Friedman 2000). Thus, its placement in second level technology education syllabi in Ireland is novel and emerging. The following sections of this paper explore, explain and evidence the changes occurring in second level Technology Education in Ireland. The following sections achieve this through an explanation of the structure and organisation of Irish Education, progressing to an exploration of the changing emphasis of design in Technology education, and explaining the rationale for the reformation with supporting evidence.

Structure and organisation of Irish education

In Ireland, three levels of education exist, known as first, second and third level (Fig. 1). According to the Irish Welfare Act (2000) compulsory education exists from 6 years of age up-to 16 years of age or 3 years of second level education. An additional, optional level of schooling exists, known as third level. Figure 1 illustrates a simplified structure and organisation of the Irish education system ("Appendix 1").

As Fig. 1 illustrates, second level education is classified into two cycles; junior and senior. In the current Junior Cycle, students study a minimum of eight subjects (Table 1). At the end of year-three students undertake the Junior Certificate examination. The level of study for junior cycle subjects includes higher level, ordinary level and foundation level.

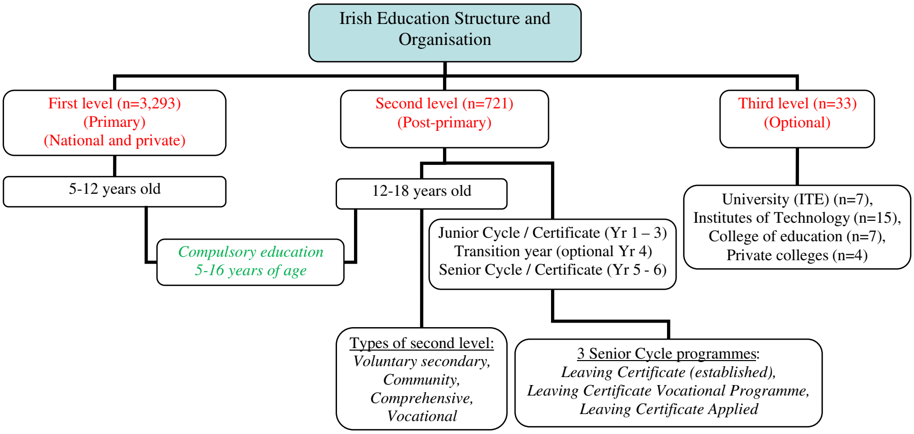

Fig. 1 Structure of the Irish Education System (DES 2004b) ("Appendix 1"). n = number of educational institutions funded by the Department of Education and Skills (www.education.ie 'Key Statistics', 2013)

Table 1 Junior cycle subjects

Core subjects (all must be studied)	Irish (Exemptions can be obtained when supported by medical reports)
	English
	Mathematics
Optional subjects sample (at least two)	History
	Geography
	Civic, social, political education (CSPE)
	Materials Technology Wood
	Metalwork
	Technical drawing
	Technology
	Art, Craft and Design
	Home Economics
	Social, physical and health education (SPHE)
	Science
	Religious Education
	Italian/French/German/Spanish/Latin and Ancient Greek
	Music
	Physical education
	Business Studies
	Classical Studies

All schools must provide the core subjects; English, Irish and Mathematics. The optional subjects vary greatly between second level school types due to differing academic focus and socio-economic factors. For example, in vocational schools, students predominantly study Technical Graphics, Art Craft and Design, Home Economics or Business Studies (Hammond and Palmer 1999). In most secondary schools, students study Science as a compulsory subject. In community or comprehensive schools, the compulsory common core of subjects is not defined. However, the three main categories of school types ("Appendix 2") and their associated ethos are becoming dispersed due to amalgamations and other restructuring processes at second level, primarily due to economic factors (Darmody and Smyth 2013). As a result, the 'traditional' subject department is becoming more universal to meet the students' needs and the demand in a catchment area.

The latter 3 years of second level education are known as senior cycle (Fig. 1). The purpose of senior cycle is to develop each student's full potential and prepare one for further education or training, or for the world of work (DES 2004a). The initial year of senior cycle is known as the Transition Year Programme (TYP), which is optional and available in most schools since 1994. TYP serves the prime purpose of broadening students' development in an educational, social and work-based environment. The TYP website outlines the ethos as a "*bridge to enable students to make the transition from the more dependent type of learning associated with Junior Cycle to the more independent learning environment associated with Senior Cycle. It encourages the development of a wide range of transferable critical thinking and creative problem solving skills.*" (http://ty.slss.ie/). TYP also allows students to sample the senior cycle subjects prior to selection and commencement of the Leaving Certificate programme, which are the latter 2 years of senior cycle. There are three separate Leaving Certificate programmes—the established Leaving Certificate (LC) (majority participate in), the Leaving Certificate Vocational Programme (LCVP) or the Leaving Certificate Applied (LCA). Students must participate in one of the Leaving Certificate programmes. Students must study a minimum of five subjects from the subject departments in senior cycle (Table 2). On completion of senior cycle students complete the Leaving Certificate Examination.

To achieve entry to third level, a minimum of six senior cycle subjects must be undertaken (Table 2). Third level education is optional, with less than half of second level students advancing to third level, which is dependent on socio-economic factors and Leaving Certificate examination points. The Central Applications Office (CAO) processes applications for undergraduate courses in Irish Higher Education Institutions. The CAO 'points system' has a benchmark of 600 points,[1] including a pass in English, to gain entry to third level. In Ireland, there are four main third level educational institutions; university, institute of technology, college of education, and private colleges (Fig. 1). There are two Initial Teacher Education (ITE) providers for Technology Education subject teachers in Ireland; the University of Limerick, as the main provider (n = approx. 120 per year) and Galway-Mayo Institute of Technology, catering for a small cohort (n = approx. 16 per year). These two institutions also provide a Professional Diploma in Technology Education, catering for a small cohort (n = approx 20 per year).

Historically exploring the changing emphasis of design in Irish Technology education

Teacher training has been causal to the epistemological shift towards design activity in Technology Education at second level in Ireland. In recent years, educational policy makers have also played a significant contribution towards the changing emphasis of design in Technology Education, which will be discussed in the following section. Design activity from an educational context is relatively new, with design historically passed through the eras by means of tradesman-apprentice. In addition, design as an academic

[1] From 2012, 25 Additional points are available to students taking higher level Mathematics.

Table 2 Senior cycle subjects

Subject department	Subject
Practical	Construction studies
	Engineering
	Technology
Artistic	Art, History and Appreciation
	Design and Communication Graphics
	Music
Humanities	English (compulsory pass)
	Irish
	Other language (French, German, Spanish, etc.)
	Classical Studies
	Geography
	History
	Hebrew Studies
Business	Economics
	Agricultural Economics
	Accountancy
	Business
Science	Mathematics
	Applied Mathematics
	Agricultural Science
	Physics
	Chemistry
	Physics and Chemistry
	Biology
Social	Home Economics, Scientific and Social
	Religious Education (can also be taken as Non Examination)

subject in third level institutions developed in the past half century (Friedman 2000), thus a pedagogical approach is continually being developed.

A record of the history of design activity in Technology Education from an Irish context is sparse, which suggests two main points; firstly, the lack of design activity and secondly, the placing of design activity in an educational context. It is over 40 years since the first Technology Education teacher entered the Irish education system (Leahy 2009). Over this forty-year period many institutions have contributed towards the training and qualification of Technology Education teachers.

In 1927, the Department of Education of the newly formed Free State took a decision to train teachers of both Woodwork and Metalwork. This was one of the first education initiatives of the new state. The decision was prompted by a need for teachers of practical subjects. These were to serve in the new school system, which would arise as a consequence of the proposed Vocational Education Act 1930. In Ireland, the first period of practical teacher training occurred in the Technical Institute Ringsend, Dublin and in Colaiste Carmain, Gorey, County Wexford. The entry requirements to these training courses required candidates to hold an apprenticeship qualification and pass a specified number of technical and technological examinations. This mode of entry to a teacher training institution was unique in the context of the rather poorly industrialised Ireland of the time. However, it was commonplace in the industrially developed areas of Europe, such as Germany and Scandinavia.

For the first 30 years the Ringsend and Gorey 2-year training courses operated with a biennial intake of sixteen trainees, with each course finishing before another started. The award granted was a Manual Instructors Certificate of the Department of Education. Design education did not have a strong presence within these training institutions as the entry requirements and award suggest. In 1972, two further training institutions were established, one in Cork and the other in Bolton Street, College of Technology, Dublin, which ran parallel to Gorey and Ringsend. Bolton Street also housed the College of Architecture, which gave a perspective on design education. However, design education was not a significant component of these programmes. Shortly after this, in 1979, a purpose built Science and Technology building at Thomond College of Education (TCE) in Limerick was established. TCE was established as the National Centre for the training of specialist teachers of general and rural science, metal and engineering technology, physical education and wood and building technology. Within TCE, design activity on a professional level was evident; however, it was not established from a pedagogical perspective.

In 1991, legislation was enacted, integrating Thomond College of Education with the University of Limerick (UL). The University of Limerick was the initial provider of graduating teachers for ‘Technology Education’, and also the first official implementer of design activity as a module for teacher training. Concurrent with UL, though under different institutions, Galway-Mayo Institute of Technology (GMIT) established a Bachelor of Science in Design and Technology Education in 2006. This degree programme allows graduates to teach Materials Technology (Wood), Technical Graphics, and Construction Studies. The GMIT Letterfrack campus is an established furniture design college, thus design practice is established and takes focus in the teacher training curriculum.

Since the establishment of the subject institutions, different emphasis for training of ITE in Technology Education has occurred. This has resulted in a range of practices and values surrounding Technology Education currently existing in second level education. Little evidence is available to suggest that design is seen as core activity for the majority of teacher training in Ireland. The lack of design activity was primarily due to the high craft-based skill within Technology Education, especially in Metalwork. However, reformation initiatives introduced to schools at senior cycle by the National Council for Curriculum and Assessment (NCCA) were to a large extent design driven. With the reformation, this high craft focus is adapting to include a conceptually rich design based practice prior to realisation.

This changing emphasis is evident through the general aims for senior cycle Technology Education, which include:

- “To contribute to a balanced education, giving students a broad and challenging experience that will enable them to acquire a body of knowledge, understanding, cognitive and manipulative skills and competencies and so prepare them to be creative participants in a technological world.
- To enable students to integrate such knowledge and skills, together with qualities of cooperative enquiry and reflective thought, in developing solutions to technological problems, with due regard for issues of health and safety.

- To facilitate the development of a range of communication skills, which will encourage students to express their creativity in a practical and imaginative way, using a variety of forms: verbal, graphic, model, etc.
- To provide a context in which students can explore and appreciate the impact of past, present and future Technology education on the economy, society, and the environment" (NCCA 2007).

These Technology Education general aims support the changing emphasis toward design from the historical dominance of 'doing' craft practice towards a holistic creative design practice. However, it must be clarified that practice does not always reflect policy. From a design perspective in Technology Education Ireland, design activity was, and still is for some, primarily carried out in terms of realisation, which is a similar practice occurring in the English system (Martin and Owen-Jackson 2013; Barlex and Trebell 2008). This approach to design-based activity is also highlighted by Hennessy, whereby design activity is "after-the-fact fashion" (2000, p. 50) based on an aesthetic feature of an artefact. This vocational education focus limits ones development towards a modern technological literacy (O' Sullivan 2013).

In addition, it is evident from analysing Technology Education assessment elements in the context of 'artefact' and 'design', the dominance in assessment is towards the 'product' rather than the 'process', especially in junior cycle Technology Education (Table 3). From the assessment percentage breakdown, one can identify the dominance of the 'artefact' in both junior cycle (64.9 %) and senior cycle (53.5 %) in comparison to 'design' in junior cycle (35.1 %) and senior cycle (46.5 %). From these percentages, the recent revisions in senior cycle Technology Education are progressing towards a more balanced approach between the 'design and make'. While there is a great proportion of design activity evidenced from the assessment weightings, this practice is gradually influencing the Junior Cycle programmes but reformation in these subjects is needed to promote this on a policy level. In junior and senior cycle the balance between artefact and design focus in the assessment is 64.9:35.1 % and 53.5:46.5 % respectively. This is positive with respect to the transition and progress the current Technology Education curricula are in. Evidence of this progress is outlined in the following section. It must be highlighted that separating the 'design' from the 'make' in this analysis does not reflect best practice for Technology Education. In addition, some elements of design cannot be classified as solely design. For example, in many outputs for the 'Design and Communication Graphics' project work, design is represented as the student's ability to present or communicate a PhotoWorks drawing. The author is also cognisant that the principle of design is a fundamental and underpinning element in Technology Education.

The dominance of practical craft activity in Irish Technology Education is due to many reasons; firstly, students are not cognitively exposed to sufficient "theoretical reflection about the nature and the influences of technological activity" (Black 1998, pp. 24–30) and secondly, the difficulty in expressing and communicating inner thoughts in a non-verbal subject area (Berglund and Leifer 2013). In addition, effectively implementing a practice in a classroom/laboratory that does not wholly represent the 'true' practice occurring in industry and professional design practice with respect to 'conceptual' design activity, leads to ad hoc practice, and often assessment driven practice. This highlights the divided and superficial knowledge and practice between second level education and professional design activity. However, Irish educational institutions have acknowledged the value and knowledge of Technology Education from a practical intellect and continue to pursue the development of design in ITE Technology Education. In addition, Technology Education in second level is consequential for students continuing third level studies in Science,

Table 3 Craft/Technical practice (artefact) versus design practice (portfolio) in Technology Education

	Artefact (%)	Design (%)	Total weighting (%)
Junior cycle	(focusing on higher level assessment only)		
Materials Technology Wood	50	16.6	66.6
Technology	25	25	50
Technical Graphics	0	0	0
Metal work	25	12.5	37.5
Weighting	64.9	35.1	100
Senior cycle			
Construction studies	12	18	30
Technology	25	25	50
Design and communication Graphics[a]	18.75	21.25	40
Engineering	25	0	25
Weighting	53.5	46.5	100

[a] Previous prerequisite subject Technical Drawing had nil/zero assessment in the area of design

Technology, Engineering and Mathematics (STEM). The impact of this student cohort continuing studies in STEM at third level is evident by 28.36 % of students progress to study science and engineering; essentially 16,071 students were studying engineering, 24,203 studying science, and 142,718 students overall (HEA 2012).

Explaining the changing emphasis promoting design in Technology Education

Amongst Irish second level subjects, Technology Education, as an academic subject, is classified by many as the poor relation. This view is supported by a statement by MP John Hayes, where “vocational learning has been seen as the poor relation of academic learning” (Wolf 2011, p. 6). However, it should be emphasised that Technology Education is “recognised as a distinct area of education” (McCormick 1991, p. 41). The nature of Technology Education is defined by the NCCA as “a distinct form of creative activity where human beings interact with their environments, using appropriate materials and processes in response to needs, wants and opportunities” (NCCA, Curriculum online, accessed on www.curriculumonline.ie). The Irish Technology Education reformation displays many characteristics similar to the Finnish Technology Education, which is mainly a design approach that has evolved from the craft-oriented approach (Alamäki 2000, pp. 19–23). However, in Irish second level Technology Education, elements of vocational education still exist, which have impacted on higher cognition and critical thinking required for design-based activities. The rationale for these impediments is primarily due to the historical focus on ‘doing’ craft practices rather than advancing with a holistic design practice. Since the 2006 reformation of Technology Education, the subjects strive to prosper beyond vocational education towards a holistic design-based education. With the reformation of Technology Education the design-based values are changing the emphasis of vocational practices to incorporate the higher cognition activities. This educational change is improving the student experience facilitating distinctiveness and diversity in students’ full development of their capabilities and potential, which is evident from the rationale for the Technology Education subjects (Table 4) and the State Examinations Commission (SEC), Chief Examiners Reports (SEC 2009a, b, c, 2011).

Since 2006, Irish Technology Education policy makers have proposed a stronger emphasis on design through problem solving and factors influencing design and realisation, which is evident from the SEC, Chief Examiner's statements below (Carty and Phelan 2006) (NCCA 2006) (SEC 2009a, b, c), (SEC 2011). The following extracts (A-D) display evidence of the reformed second level Technology Education (Design and Communication Graphics (A) and Technology (B)) in comparison to the older curricula (Construction Studies (C) and Engineering (D)) awaiting reformation implementation. This is evidence of a changing technological environment promoting design activity. Design and Communication Graphics (A) has introduced a skill-set necessary for the promotion of conceptual design activity. Technology (B) has promoted a technological literacy through problem solving, creativity, and innovation. In addition, the design process is applied in a more meaningful way adding value to the design activity experience for the student, which can be transferred to future design based activities. These two subjects (A and B) are in contrast to the dominant craft skill practices evident in Construction Studies (C) and Engineering (D).

Design and communication graphics (2007 syllabus)

> The exploration of the design brief was excellent in some cases and satisfactory overall (SEC 2009a, p. 56)
>
> While many candidates produced excellent freehand presentation drawings, this is an area that could be further emphasised, developed and promoted. The over use of colour, in some cases, did very little to enhance the quality or presentation of the sketches (SEC 2009a, p. 56)
>
> The dedication of the teachers and their ability and willingness to embrace change is clearly manifest from standard of work presented for examination by candidates (SEC 2009a, p. 56)

Technology (2007 syllabus)

> Examiners noted the diversity of design skills in many centres, including creativity, innovation and problem solving" (SEC 2009c, p. 33)
>
> A significant factor in the impressive scoring by candidates at Higher Level was, without doubt, the performance in the design folio section of the coursework. Traditionally this has been a weaker link at junior cycle Technology (SEC 2009c, p. 45)

Construction studies (1984 syllabus)

> Many of the furniture type coursework presented for assessment were not designed by the candidates but were realisations of existing designs, sourced from books and magazines. Such derivative work does not usually provide sufficient opportunities for the development of the higher order skills of research and design, expected in particular of Higher Level candidates (SEC 2009b, p. 43)
>
> Make sure, particularly at Higher Level, that the higher order conceptual skills of analysis, design, synthesis and evaluation are demonstrated in the folio and that an evaluation and personal reflection on the process is also included in the folio (SEC 2009b, p. 45)

Table 4 Technology Education subjects

Junior Cycle Subject	Year commenced	Rationale (75 h/year/subject)
Materials Technology Wood	1992	Application of knowledge and materials processing skills, through the mechanism of the design process, to facilitate students' exploration of their role in making and shaping their environment.
Technology	1989	Technology is the achievement of human purposes through the disciplined use of materials, energy and natural phenomena. Technology education involves students in developing their knowledge and skills, and in applying these through suitable tasks.
Technical Graphics	1992	Development of the range of skills associated with the management of spatial problems and the graphical communication of spatial ideas and solutions.
Metal work	1992	Activity based course focusing on metal, how to work with it and how to assemble different parts. Other materials such as wood and plastics are investigated and used in project work. Also working with basic electronic components.
Senior Cycle subject		(95 h/year/subject)
Construction Studies *(formally Building construction) (Impending reform to Architectural technology)*	1984	Knowledge and skills associated with construction technology and construction materials and practices. Achieved through theoretical study and integrated practical projects which provide a basis for the thorough exploration of materials and processes.
Technology	2007	Combines knowledge, understanding, skills and attitudes, and empowers students to become autonomous problem solvers. It uses a design and make approach where students learn to think through a structured approach which encourages creativity in response to needs and opportunities, with sensitivity to its impact on society and on the environment.
Design and Communication Graphics (Reformed from Technical Drawing)	2007 (replaced Technical Graphics, 1984)	Development of the students' cognitive and practical skills (graphic communication, creative problem solving, spatial visualisation, design capabilities, computer graphics and Parametric CAD modelling). The creative and decision making capabilities of students in the activities associated with design are developed through three principal areas of study: design and communication graphics, plane and descriptive geometry, and applied graphics.
Engineering *(Impending reform Engineering technology)*	1985	Development of entrepreneurial expertise, autonomous learning and a variety of transferable cognitive and practical skills. A strong emphasis is placed on problem solving, on research and on the design and manufacture of useful artefacts. Within this framework, skill in decision-making is also developed.

Engineering (1984 syllabus)

> Students should be provided with regular opportunities to apply the design process which they have learned through coursework (SEC 2011, p. 45)
>
> Ensure that their individual final solution provides an opportunity to demonstrate a diversity of design skills, practical skills and engineering processes (SEC 2011, p. 46)

Throughout Europe, Technology Education subject knowledge, structure and content varies greatly. In relation to Technology Education, with respect to design activity, it should be an integrated activity (Williams 2000, p. 48). The rationale for different forms of Technology Education is grounded in the temporal and political context of the country (Owen-Jackson 2013). Technology Education, in an Irish second level educational context, deals with eight subjects (Table 4). With the change in Senior cycle Technology Education from industrial practices to a design approach; a holistic design activity is gradually permeating the Junior Cycle subjects. An example, which portrays this transfer of skills, is from Design and Communication Graphics, where prototyping via parametric modelling on SolidWorks is now practiced in Materials Technology Wood (Table 3). The rationale is based on the need for developing critical thinkers and problem solvers throughout Technology Education, not just when students enter Senior Cycle.

This need is akin to the foreword by the Minister for Education and Skills, Ruairí Quinn that "Ireland needs students and graduates who are critical thinkers and problem solvers" (HEA and NCCA 2013, p. 3). Supporting this statement, the Report of the Innovation Taskforce, an important element of the Government's Plan for dealing with the challenges facing and building the Irish economy, researched the principles that would transform Ireland into an International Innovation Hub. The Innovation Taskforce identified six principles as fundamental to creating this ecosystem. The fourth principle stated that "An education system which fosters independent thinking, creativity and innovation is vital to achieving the Smart Economy" (Innovation Taskforce 2010, p. 5). The changing emphasis on design in Technology Education in the recent years, with all programmes having major elements of design activity (Table 3), supports and represents such principle. Technology Education in Ireland illustrates the strong concentration of design-based activity, ranging from 66.6 to 25 %, across the current junior and senior cycle Technology Education subjects, which facilitates and promotes thinking, creativity and innovation. However it must be noted, as highlighted in Table 3 above, the weighting of design-based activity is dominated by craft practice.

While two senior cycle Technology Education subjects await reformation, halted due to economic factors, continued support exists to pursue the development of existing Technology Education subjects. Established in 2006, hosted by Galway Education Centre, the Technology Subjects Support Service (T4) initially supported schools in the implementation of the reformed Technology Education subjects, through development courses or in-services. The T4 primarily dealt with subject content and assessment rather than the pedagogical approaches to aid the implementation or holistic approach of design activity. This content driven approach, as evident by the knowledge and skills topics for Technology Education Continued Professional Development (CPD), is highlighted in Table 5. Policy makers continue to challenge with design driven assessments to engage curiosity, creativity and individualism in Technology Education students and teachers. Since 2011, T4 has united with the Professional Development Service for Teachers (PDST), which continues to guide and promote the development of a technological environment for Technology Education in Ireland.

Table 5 Technology education continued professional development (CPD) (Accessed at: http://www.t4.ie/cpd_intro.htm)

Topic	Component
Option: manufacturing systems (2)	Project management Concurrent engineering Manufacturing system design and control
Option: materials technology	Focus on option content Variety of teaching resources Smart materials
Option: applied control systems	Pneumatics Theory and components. Hands on circuit design and construction.

Technology Focus: knowledge and skills associated with the topics listed

Conclusion

This paper explored and explained the current changing emphasis of design in second level Technology Education. This changing emphasis is continually developing with the revision of senior cycle progressed half-way, with two other subjects awaiting proposal implementation. A significant factor in the inclusion of design in technology education at second level has been the increased focus of design at third level in initial teacher education technology subjects. However, subtle changes have occurred driven by assessment, which demonstrates the need and awareness for change through design. 'Design and make' deals with a broad range of skills, from communication to the finished design artefact. As outlined in the Junior Certificate, Materials Technology (Wood) syllabus; "*This* (project design and make) *is concerned with solving practical problems in a manner which reflects individuality and creativity*" (NCCA 1991). The subject matter for design activity does not wholly aid student's understanding of the practice of design activity. This is reinforced by Kimbell and Perry, "the subject matter of design and technology is our made world", it "is about creating change in the made world; about understanding the processes of change and becoming capable in the exercise of change-*making*" (Kimbell and Perry 2001, p. 3). Design nurtures a broad range of skills for life-long learning, which facilitate students' ability to be agents of change and innovation for economic, cultural and social growth.

Technology Education in second level has initiated a change from a traditionally vocational culture towards a design-driven technological environment. Technology Education prepares students to meet the needs of the future. Paraphrasing educator Karl Fisch; students are currently preparing for jobs that do not exist yet, using technology that has not been invented, to solve problems that are not evident as problems. The amount of information is doubling every 2 years. It is predicted that by 2015 information will double every 72 h (Peppers 2009). The future of Technology Education Ireland holds mixed views in terms of the pursuit of continued reformation towards a design-driven ethos. As an optional subject in second level education it beholds great motivations and values for students. Continued partnerships are required between the levels of education (institutions) and external bodies to build the epistemological frameworks in the context of design-driven activities thus strengthening Technology Education for the future.

Appendix 1

See Fig. 2.

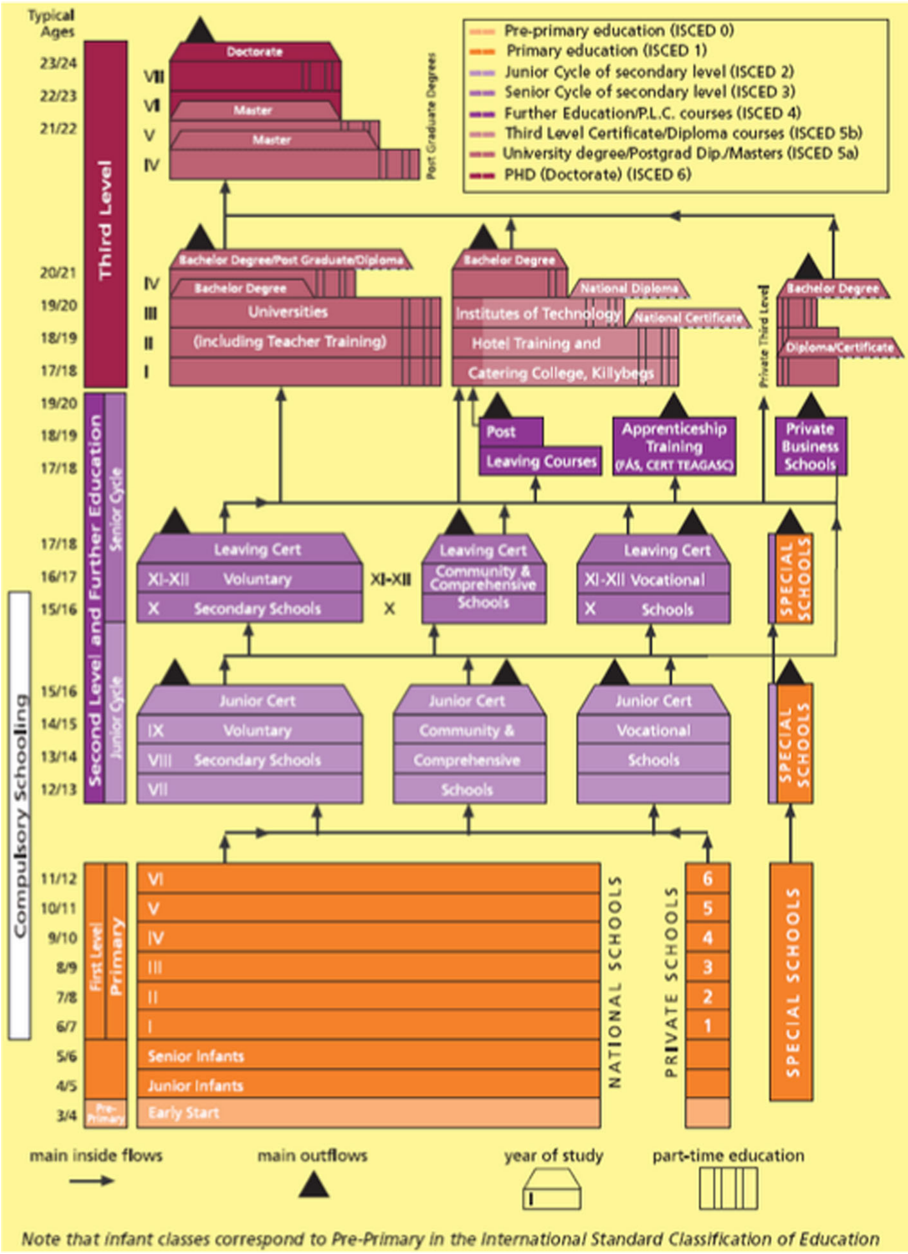

Fig. 2 Irish Education Systems' structure

Appendix 2

See Table 6.

Table 6 Second level school types and characteristics (OECD and Gallagher 2003)

School type	Characteristics
Secondary schools	Most popular, providing for fifty five percent of students. State-subsidised but usually owned by religious groups, organisations or privately owned. Small numbers of secondary schools are fee paying. Traditionally provide a more 'academic' education. In recent years they have introduced practical and technical subjects.
Vocational schools/ Community colleges	Cater for approximately 34 % of student population. Owned by the local authorities and run by vocational education committees or authorities, which are statutory bodies. Historically the main focus was in terms of the development of practical skills and vocational training. However, the full range of second-level subjects is available.
Comprehensive/community schools	Cater for approximately 12 % of the student population. Established by the State and are owned by partnership boards of trustees. A board of management representative of the diocesan religious authority, the Vocational Education Committee of the area and the Minister for Education and Science manages these schools. Financed entirely by the Department of Education and Science. Set up to give recognition to a compromise between Secondary and Vocational Schools. Offer a broad curriculum embracing both practical and academic subjects.

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